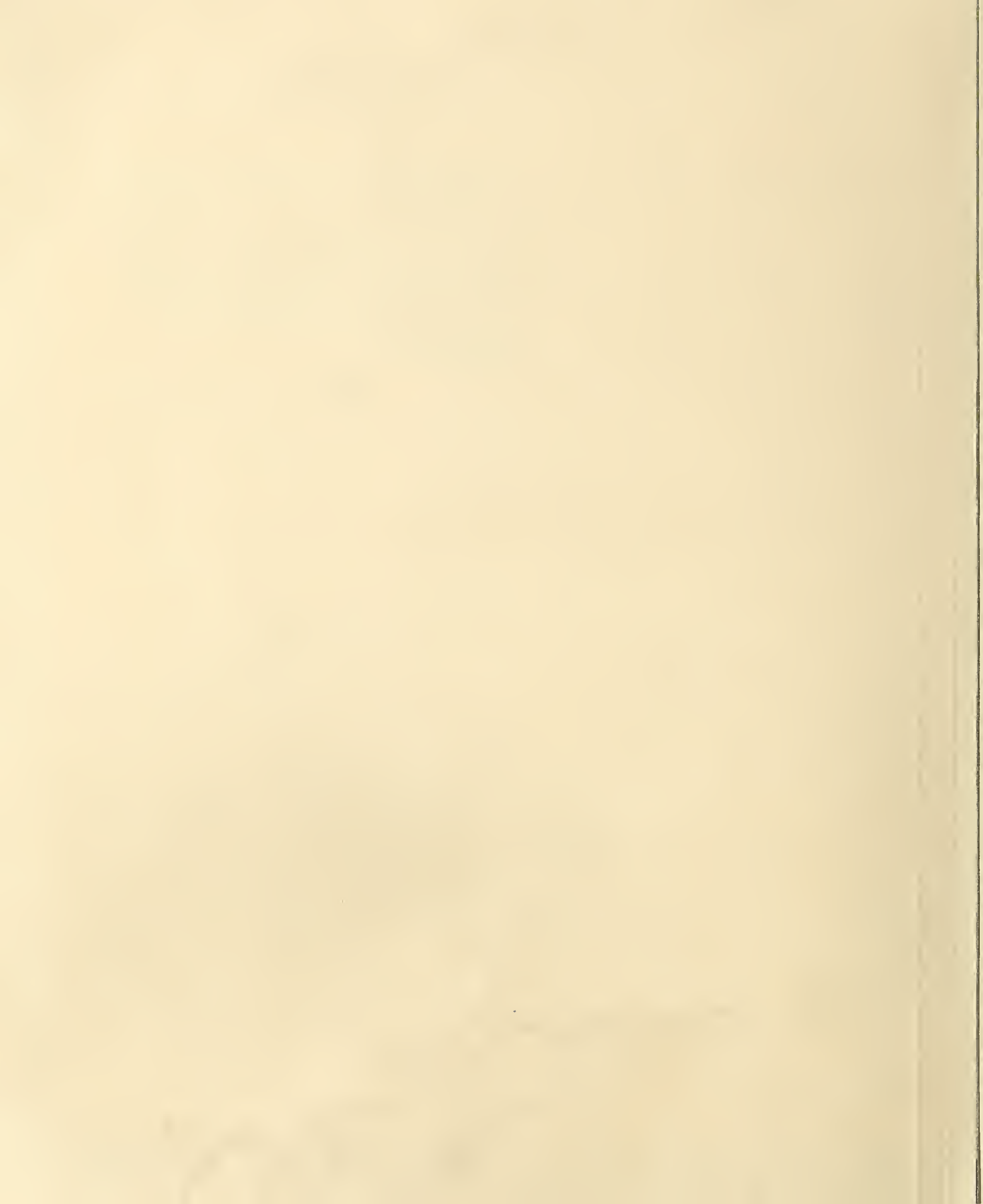


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# AGRICULTURAL Research

FEBRUARY 1954



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U. S. DEPARTMENT OF AGRICULTURE  
BELTSVILLE BRANCH

Looking Prosperous

# AGRICULTURAL Research

VOL. 2—FEBRUARY 1954—NO. 8

THOMAS MCGINTY—EDITOR  
JOSEPH SILBAUGH—ASS'T EDITOR

## Pre-spring Pessimism

Winter's not over yet, and before April exuberance rises sap-like in our bones, there's time for a cold grumble at the coming Spring. The trouble is, in bringing up the first shoots of our 1954 crops, it will also bring those ancient anti-crops, the pesky, worrisome weeds.

Find what consolation you can in knowing that we're better armed than ever before to combat the weed legions. The hoe and all its mechanical cousins are ready, as usual. And supporting this invaluable infantry is our increasing arsenal of chemical herbicides, the atomic weapons of today's weed war. They will all be sorely needed. Despite everything that farmers can do, weeds still depress the value of crops and pastures by some \$3 billion every year. And what farmers must do to prevent still greater losses costs another billion.

Though experimental use of chemicals for weed control began before 1900, as recently as 1935 only three men in the entire United States were devoting full time to weed research. The modern era in weed control didn't begin till 1944, with 2,4-D and other new plant-modifying chemicals with selective weed-killing ability.

We must admit, however, that research has made possible during the last 10 years a tremendous expansion in effective use of chemical herbicides. These compounds are now well established as supplemental tools for controlling weeds in many crops. Some jobs they alone can do, many they help do better or more economically. Twenty-five cents worth of chemicals will control wild mustard in an acre of wheat. Chemicals can reduce hoeing labor needed in cotton fields by 75 percent.

Yet we still don't make full use of the weed-killing know-how we already have. And there's pressing need for better, safer weed killers, for simpler ways to apply them, for more knowledge of their effects on plants and soils, for improved cultural practices to use with them.

Weeds still rob the soil of nutrients needed by cultivated plants, restrict crop yields, cause garlic flavor in milk, reduce hay quality, result in dockage of cereal grains at the market. Some of them harbor insect pests and fungus diseases. Until Spring warms up our optimism, we can hardly be blamed for giving a chilly winter thought to weeds.



BRIGHT-EYED chicks like this 3-day-old are the foundation of our \$4-billion poultry industry and make a big contribution to farm income in all sections of the country. (See story on page 14.)

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AGRICULTURAL RESEARCH SERVICE  
United States Department of Agriculture

# Appointments to *ARS*



Reorganization of USDA research activities is proceeding along the lines reported in our December issue (page 2). Listed below are Agricultural Research Service positions, chiefly in Washington, D. C., and at Beltsville, Md., to which appointments were made effective

January 8, 1954, by B. T. Shaw, ARS administrator. ARS Deputy Administrator is M. R. Clarkson. Director of Programs Inspection and Evaluation is K. A. Butler. Other positions, when filled, will be reported in later issues of AGRICULTURAL RESEARCH.

## **Crops**

Director of Crops Research—A. H. Moseman  
Assistant Director of Crops Research—Karl S. Quisenberry  
Assistant Director of Crops Research—Herbert L. Haller  
Chief, Field Crops Research Branch—Martin G. Weiss  
Chief, Horticultural Crops Research Branch—F. P. Cullinan  
Chief, Entomology Research Branch—Edward F. Knippling

## **Livestock**

Director of Livestock Research—O. E. Reed  
Assistant Director of Livestock Research—Hugh C. McPhee  
Chief, Animal Disease and Parasite Research Branch—B. T. Simms  
Chief, Dairy Husbandry Research Branch—Ralph E. Hodgson  
Chief, Animal and Poultry Husbandry Research Branch—T. C. Byerly

## **Farm and Land Management**

Director of Farm and Land Management—Sherman E. Johnson  
Chief, Soil and Water Conservation Research Branch—Robert M. Salter  
Chief, Agricultural Engineering Research Branch—E. G. McKibben  
Chief, Production Economics Research Branch—Carl P. Heisig

## **Human Nutrition and Home Economics**

Director of Human Nutrition and Home Economics Research—Hazel K. Stiebeling  
Chief, Human Nutrition Research Branch—Callie Mae Coons  
Chief, Home Economics Research Branch—Ruth O'Brien

## **Utilization**

Director of Utilization Research—G. E. Hilbert  
Assistant Director of Utilization Research—C. F. Speh  
Assistant Director of Utilization Research—W. M. Scott  
Chief, Northern Utilization Research Branch—R. T. Milner  
Chief, Southern Utilization Research Branch—C. H. Fisher  
Chief, Eastern Utilization Research Branch—P. A. Wells  
Chief, Western Utilization Research Branch—M. J. Copley  
Chief, Washington Utilization Research Branch—J. R. Matchett

## **Crops Regulatory**

Director, Crops Regulatory Programs—Avery S. Hoyt  
Chief, Plant Pest Control Branch—W. L. Popham  
Chief, Plant Quarantine Branch—Eugene P. Reagan

## **Livestock Regulatory**

Chief, Animal Disease Eradication Branch—R. J. Anderson  
Chief, Animal Quarantine Branch—C. L. Gooding  
Chief, Meat Inspection Branch—A. R. Miller

## **Experiment Stations**

Assistant ARS Administrator, Office of Experiment Stations—R. W. Trullinger  
Deputy Assistant Administrator, Office of Experiment Stations—E. C. Elting  
Director, State Experiment Stations Division—H. C. Knoblauch  
Director, Territorial Experiment Stations Division—D. V. Lumsden

## **Management**

Assistant ARS Administrator for Management—F. H. Spencer  
Special Assistant to Assistant Administrator for Management—H. A. Donovan

Director, Budget and Finance Division—Edmund Stephens  
Director, Personnel Division—J. H. Starkey

Superintendent, Agricultural Research Center—C. A. Logan



# Mother's Diet and Baby's Growth

HUMAN NUTRITION is the life work of some ARS scientists. One member of this group is F. A. Csonka, who's particularly interested in finding out how maternal diet affects embryo development.

Csonka is exploring this question in terms of the effect of a hen's feed on the growth of her chicks. Knowledge gained from this work with chickens will help science move ahead with human studies. Furthermore, the findings have immediate interest for poultry research.

With the hen, housing and diet control are comparatively simple. Then, too, an embryo grows all the way from cell to chick in just 3 weeks. And

the embryo's entire food supply, enclosed in the shell of an egg, is easily analyzed.

The egg includes seven different proteins, each made up of certain amino-acid building blocks. Csonka and his associates discovered that they could change the proportion of two of these amino-acids—cystine and methionine—by changing the hen's ration. That is, on a high-protein diet with casein or soybean, a hen lays eggs that are richer in cystine and methionine than she does on a low-protein diet in which corn is the main source of protein.

Suppose these eggs were hatched—would there also be a difference in the growth of the chicks? The scientists did find a difference, but it wasn't directly related to the increase in cystine and methionine in the egg. Chicks from casein-fed hens outgained chicks from the hens on a high-protein soybean ration as well as those on a low-protein corn diet.

It now appeared that casein carries a previously unrecognized growth factor—a different one from the vitamin B<sub>12</sub> normally associated with casein, liver, and cow manure—and that this new factor can be transmitted from the hen's diet to the chick just as vitamin B<sub>12</sub> can.

This is confirmed by Csonka, R. J. Lillie, and W. F. Martin in the research summarized on the opposite page. They fed four groups of 30 Rhode Island Red pullets on various rations for about 13 weeks. Then they reversed the proteins—but not the supplements—in these diets and began to collect eggs again after 2 weeks. The table shows that—

1. On unsupplemented mash, chicks from hens fed a ration containing casein grew faster than chicks from hens on a corn ration. This holds true for both the long-period experiments (compare 1 with 5, 3 with 7) and the short-period experiments (compare 2 with 6, 4 with 8).

2. Adding vitamin B<sub>12</sub> to maternal rations fed over a long period stimulated the growth of chicks on unsupplemented mash. Note that the B<sub>12</sub> was much more effective when added to the hen diet, as in Experiment 3, than it was when added to the chick diet, as in Experiment 1.

That the differences in chick growth aren't entirely related to B<sub>12</sub> is apparent from Experiments 3 and 5. Although there was substantially more B<sub>12</sub> in the Experiment-3 hens' diet and in the eggs they laid, chicks from these hens didn't gain as fast as chicks from hens on unsupplemented casein in Experiment 5.

In the maternal diets fed only a short time, B<sub>12</sub> was ineffective. It was somewhat more stimulating when added to the chick mash.

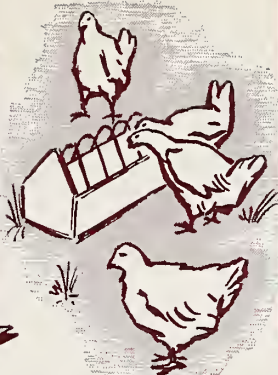
3. Cow manure improved the growth of chicks when the hens had been on a diet for a long period. After the maternal diets were reversed, however, cow manure in the chick mash didn't improve growth.

4. Using both cow manure and B<sub>12</sub> in the chick mash suppressed growth in most long-period trials, but had little effect in the others.

Several findings stand out: the unidentified growth factor in casein . . . the discovery that B<sub>12</sub> or cow manure in the chick diet may inhibit as well as promote growth, depending on the hen diet and the length of time it is fed . . . the sexual differences in chick reaction (brought out in the table) . . . the general drop in chick growth levels following the changes in maternal diets.

Csonka points out that these results, though not directly applicable to humans, have many implications for human nutrition. For example, does the value of B<sub>12</sub> depend on other components in the diet? Is an unrecognized growth factor supplied by the casein in our milk? It seems likely that such questions will stimulate further research.

# HENS WERE FED RATIONS WITH—



## HERE'S HOW THEIR CHICKS GAINED ON—



(Gain is in grams—1 gram = about 1/28 ounce—for 27 days after hatching)

WEEKS 4 8 12

1 Low-protein CORN

THEN DIET WAS CHANGED TO—

2 High-protein CASEIN

Mash

Mash +  
0.2%  
B<sub>12</sub>  
Conc.

Mash +  
5% dried  
COW  
MANURE

Mash +  
COW  
MANURE  
and B<sub>12</sub>

116

137

180

150

136

150

133

135

EXPERIMENT 1: These chicks from hens on corn ration for long period gained less than chicks in Experiment 5, where hens got casein diet for long period. B<sub>12</sub> in chick mash stimulated females.

EXPERIMENT 2: These chicks from hens on the casein for short period outgained chicks in Experiment 6, where hens got the corn for short period. Males accounted for the extra growth from B<sub>12</sub>.

3 Low-protein CORN + B<sub>12</sub>

THEN DIET WAS CHANGED TO—

4 High-protein CASEIN + B<sub>12</sub>

174

156

180

164

125

148

102

113

EXPERIMENT 3: B<sub>12</sub> in hen diet stimulated growth of chicks on unsupplemented mash (compare with Experiment 1). Cow manure was effective in chick feed, especially for females. Using both cow

manure and B<sub>12</sub> suppressed growth of males. EXPERIMENT 4: B<sub>12</sub> in hen diet gave these chicks no advantage over those in Experiment 2. Adding cow manure to the chick diet greatly inhibited growth.

5 High-protein CASEIN

THEN DIET WAS CHANGED TO—

6 Low-protein CORN

178

164

199

174

121

141

120

140

EXPERIMENT 5: On unsupplemented chick mash, females outgained males. Cow manure proved especially stimulating to the male chicks. EXPERIMENT 6: Here, as with other experiments (2, 4, 8) where

the maternal diet had been fed only a short time, adding cow manure to the chick mash did not improve growth. In Experiment 6, B<sub>12</sub> and cow manure together gave a moderate increase over cow manure alone.

7 High-protein CASEIN + B<sub>12</sub>

THEN DIET WAS CHANGED TO—

8 Low-protein CORN + B<sub>12</sub>

184

172

196

161

116

141

119

126

EXPERIMENT 7: As in Experiment 3, B<sub>12</sub> in both hen and chick diet gave smaller gains than B<sub>12</sub> in the hen diet only. B<sub>12</sub> and cow manure in chick mash were less effective than the cow manure alone.

EXPERIMENT 8: Comparison with Experiment 6 shows that B<sub>12</sub> in hen diet for a short period did not improve chick growth. (Note that most chick growth levels dropped after hen diets were reversed.)

# Ion-Exchange at work for agriculture

$\text{Na}^+$   $\text{SO}_4^{--}$   $\text{NH}_4^+$   $\text{Cl}^-$   
 $\text{K}^+$   $\text{OH}^-$   $\text{Ba}^{++}$

**F**OR many of us, "ion-exchange" is a half-familiar term designating an unfamiliar, mysterious chemical process. We may have the vague idea that it's a recent research development. Actually, though, ion-exchange has been around a long time. It has a lot to do with helping or hindering plants in getting nutrients from the soil. And it's the basis for water-softening systems and laboratory and industrial purification processes that have a history going back to the ancient Greeks.

In the past 20 years, however, we have gained much new knowledge of how ion-exchange acts in nature, and how its principles can be put to work for the benefit of research, industry, and agriculture.

Ion-exchange is a reversible chemical reaction that takes place between

an insoluble substance—the ion-exchanger—and a solution. The ions (first named by Faraday, from a Greek work for "traveler") involved in this process are electrically charged chemical particles.

There are two types of ions. Some are atoms or groups of atoms that have *lost* one or more electrons, and so have a positive electrical charge. These are called cations (CAT-eye-ions). One of them is the hydrogen ion ( $\text{H}^+$ ), always present in water. The other type are chemical particles with one or more *extra* electrons. These are negatively charged and are called anions (ANN-eye-ons). Among them are the chlorine ion ( $\text{Cl}^-$ ) and hydroxyl ion ( $\text{OH}^-$ ). Both cations and anions evolve naturally when acids, bases (alkalies), and salts are dissolved in water.

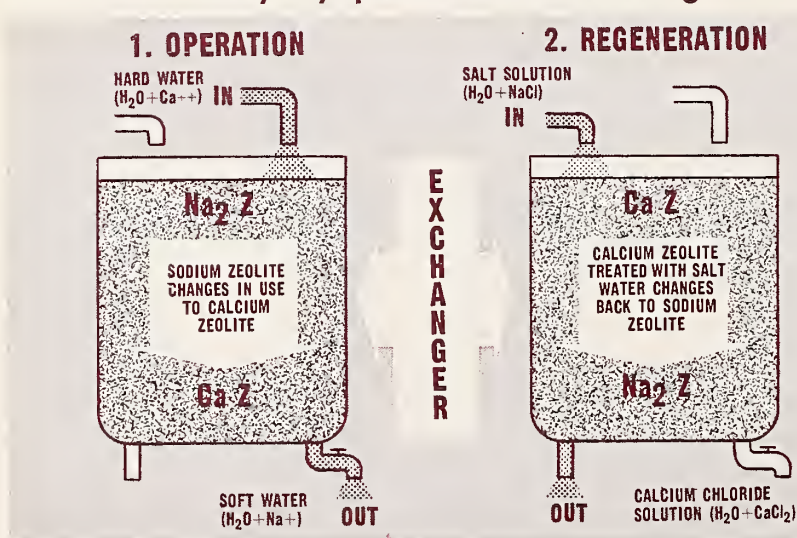
What happens in ion-exchange is that certain cations or anions—depending on the exchanger used—are taken out of a solution when it comes in contact with the insoluble ion-exchange material. These ions chemically unite with the exchanger, which in turn releases other ions—different chemically, but having a like charge—into the solution.

Thus, it's possible to use an ion-exchanger to chemically remove an unwanted substance from a solution. Of course, the exchanger puts another chemical in place of the one it takes out. This replacement substance may be left in the solution or removed by further ion-exchange, using a different exchanger. Sooner or later in the process, you can substitute—if desired—hydrogen or hydroxyl ions (see above) for the ions removed by the exchanger. So finally you can remove all unwanted ions, replacing them in the solution simply by more water (since H ions plus OH ions will produce  $\text{H}_2\text{O}$ ).

Ion-exchange in the soil affects plant growth, because it often determines whether certain plant nutrients will go into solution with soil moisture and can be absorbed by plants, or whether nutrients will become (or remain) bound to insoluble soil substances, so that they are not available to plants.

Man has been able to adapt ion-exchange to his own uses in a limited way since Aristotle's time. Purifying water by running it through certain kinds of earth has been the most important of these applications. The ion-exchange properties of various clay-like substances, called zeolites,

## One of its everyday jobs: Water Softening



ZEOLITE ion-exchanger (shown here in simplified form) softens water by replacing the "hard" calcium (Ca) ions with those of sodium (Na). When exchanger's capacity is used up, it can be regenerated by treatment with salt water, which restores the sodium ions lost in normal operation.

were first described by an English soil chemist in 1850. Zeolites and other natural ion-exchangers, however, are relatively slow and inefficient in action. Modern developments in using the process date from 1935, when the first ion-exchange resins—more efficient, man-made exchangers—were synthesized.

Usually produced in granular form, these resins are compounded either as cation exchangers or anion-exchangers. The two may be employed separately or in combination, depending on whether cations, anions, or both are to be removed from a solution.

After a certain time in use, an exchange resin finally has combined with as many of a solution's ions as it effectively can. Then its ion-exchanging ability must be regenerated by treating it with a solution containing an excess of the ions that it has released (see diagram).

Ion-exchange resins helped to make possible the development of simple,

light-weight gear—practical for aviators' survival kits or use in lifeboats—that readily converts sea water to drinkable form. Purification of water and various aqueous solutions by ion-exchange resins has become increasingly important in industry. The economic feasibility of employing ion-exchange principles to make sea water and inland brackish waters fit for use in irrigation is being actively investigated.

Scientists of USDA's Southern Regional Research Laboratory have developed a process for improved purification of sugar-cane juice by ion-exchange. Their method is a variation on a conventional ion-exchange procedure used to purify beet-sugar juices. In the older process, the juice must be cooled to prevent loss from inversion—i. e., the change of sucrose to so-called reducing sugars, which interfere with the desired crystallization. But in the warm regions where cane-sugar factories are located, the

cost of cooling largely offsets gains in ease of operation and increased yields of sugar obtained by conventional ion-exchange. The Southern Laboratory therefore devised a reverse-cycle procedure, using newer types of exchange resins, which largely eliminates sugar inversion without need for cooling the juice.

Other research at the laboratory has shown that certain chemically modified cotton fabrics—including phosphorylated and aminized cottons—have ion-exchange properties similar to those of ion-exchange resins. Such fabrics are useful as both filters and ion-exchangers. They can physically remove particles suspended in a solution, and at the same time chemically displace other substances through ion-exchange.

These fabrics make possible moving-belt ion-exchange systems—with continuous regeneration as part of the process—that work faster than conventional systems using resins.

## **Rutin studies suggest flavonoids may have role in metabolism**

The drug rutin is one of several pigment-like substances called flavonoids found in many plants. From recent studies of rutin, ARS scientists conclude that this general class of compounds may have important effects on the body processes of humans and animals.

Very little is known about the way flavonoids act in the body. They are all relatively insoluble in water. Despite this, however, it appears that they can be absorbed by body tissues. Thus, like rutin, they may have physiological effects.

During the past 10 years, the Eastern Regional Research Laboratory at Wyndmoor, Pa., has developed extensive technical information on rutin. Methods developed at the Wyndmoor laboratory were used for commercial production of rutin from green buckwheat plants. This drug, chemically

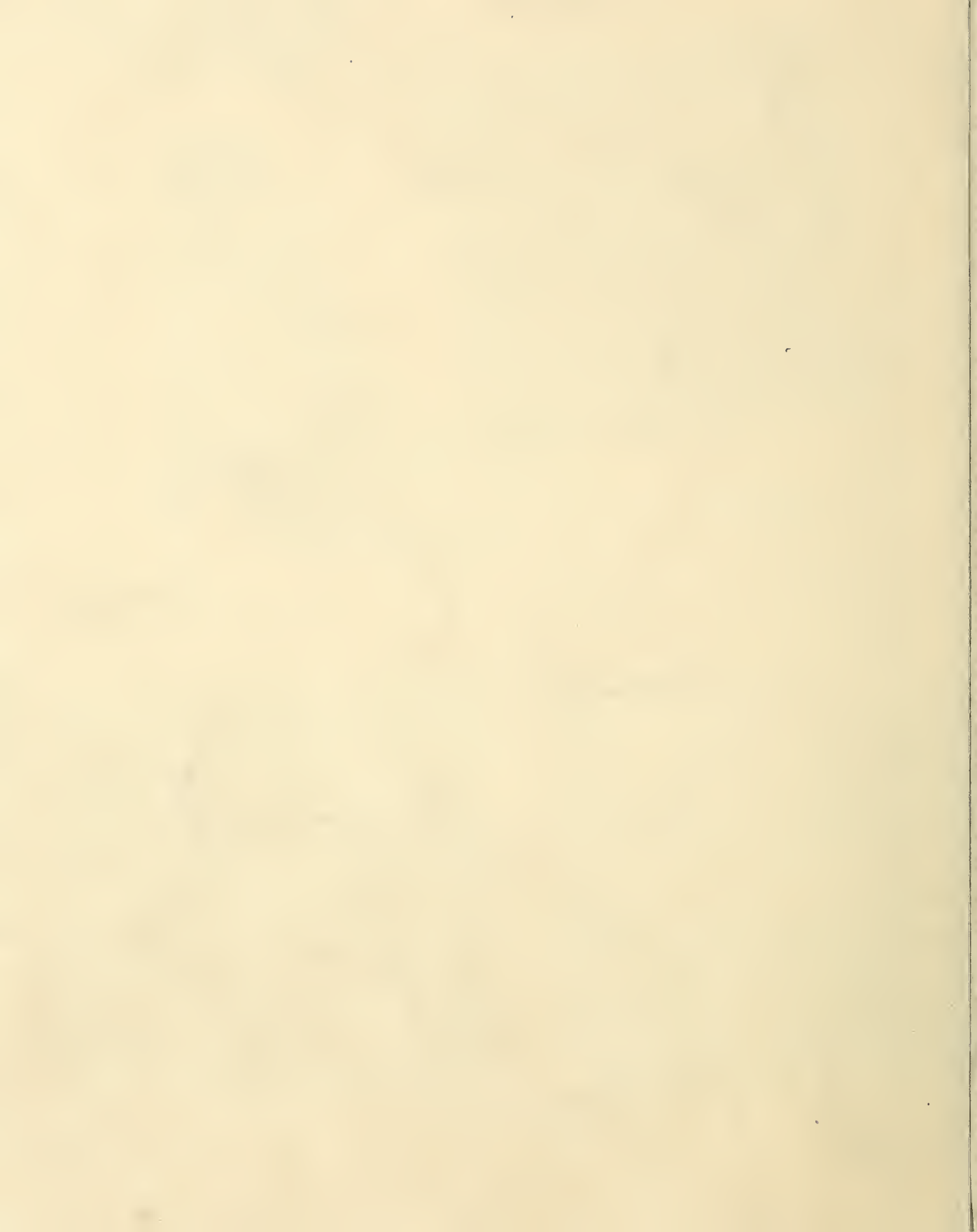
identified as a rhamno-glucoside of quercetin, is obtained as a yellow powder. Prescribed for preventive treatment of certain hemorrhagic conditions, it is normally administered orally in tablet form.

Some patients given rutin, however, received little or no benefit from it. These cases resulted in controversy as to the mechanism of the drug's absorption and its ultimate fate in the body. Then, in 1950, medical researchers reported that rutin was not absorbed from the gastrointestinal tract but was destroyed during excretion. This finding was based on failure to discover any trace of rutin in the urine. A question arose as to whether the drug actually had any medical value.

Investigations by pharmacologists at the Western Regional Research Laboratory, Albany, Calif., now show

that rutin fed to rabbits undergoes marked changes during metabolism. Instead of being excreted as rutin, the drug is broken down into a number of compounds of smaller molecular size. One of these has been isolated and identified as 3,4-dihydroxyphenylacetic acid, a substance not normally present in rabbit urine. The amount of this acid recovered indicates that at least 25 percent of the rutin that was given orally to the rabbits was absorbed.

Isolation and identification of other rutin metabolites is proceeding at the California laboratory. Besides providing information of medical value concerning rutin, these studies have pointed the way to better understanding of other flavonoids present in a great many foods and feeds and their possible importance for human and animal development.





## Hills . . . or . . . Strips

SOIL CONDITIONERS give good results in hills or strips, which take only a third the material of a broadcast treatment. Large-rooted plants such as tomatoes and cabbage need a strip or hill 18 to 24 inches wide. This can be only 12 inches or less for small

vegetables. Conditioner should be well mixed to depth of 6 inches, which is easiest when soil is fairly dry. (About 2½ ounces of conditioner treats a 2-foot tomato hill at the rate of 2,000 pounds per acre.) It's best to delay planting and watering a day or two.

For 'problem soil' in the home garden:

## Synthetic

# Conditioners

Many home gardeners run into "problem soil" that's tight and heavy. It looks good at planting time—but one pounding rain cakes such soil and packs it down. Seedlings have a hard time getting through. More rain, together with trampling of the soil, makes the situation worse as the season moves along.

What's the trouble? Such problem soils are loaded with fine silt or clay, or both. And there's shortage of humus—from decaying organic matter—which binds tiny soil particles into larger crumbs, or aggregates.

Synthetic soil conditioners can help relieve this difficulty. These materials, introduced 2 years ago, are still too costly for extensive, plow-layer treatments on the farm. But ARS scientists R. E. Wester and H. T. Hopkins have found that conditioners can be both practical and economical for garden use (see pictures).

Wester and Hopkins ran trials on Beltsville and Sassafras silt loams—local problem soils that are high in silt. Plenty of water and fertilizer were applied, so the only limiting factor in the trials was soil structure.

Two conditioners—100 percent active material—were used in most of the experiments: VAMA (partial calcium salt of vinyl acetate and maleic acid) and HPAN (sodium salt of hydrolyzed polyacrylonitrile). Various formulations of both are available under trade names.

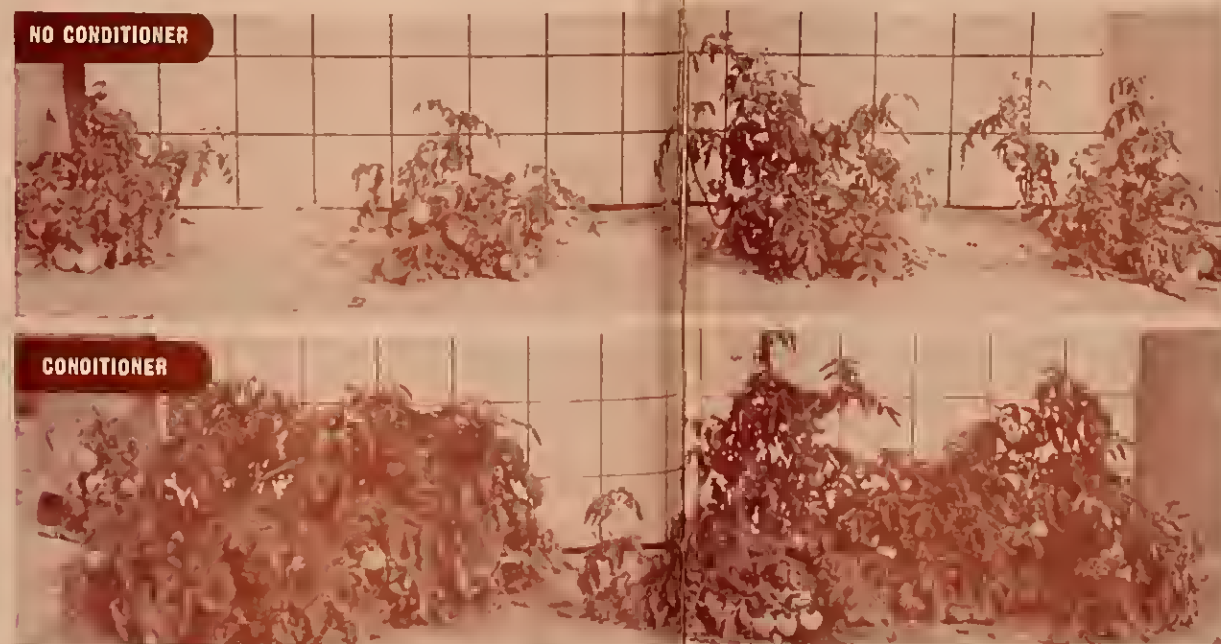
Chemists know these materials as linear polymers—compounds with long-chain molecules. They stabilize the soil crumbs, some scientists believe, by linking the negatively charged particles of clay.

The result is that properly prepared soil stands up under weather and tillage all season or even longer without losing its loose, porous structure. Water infiltrates to the soil around crop roots instead of running off the surface and carrying the soil along.

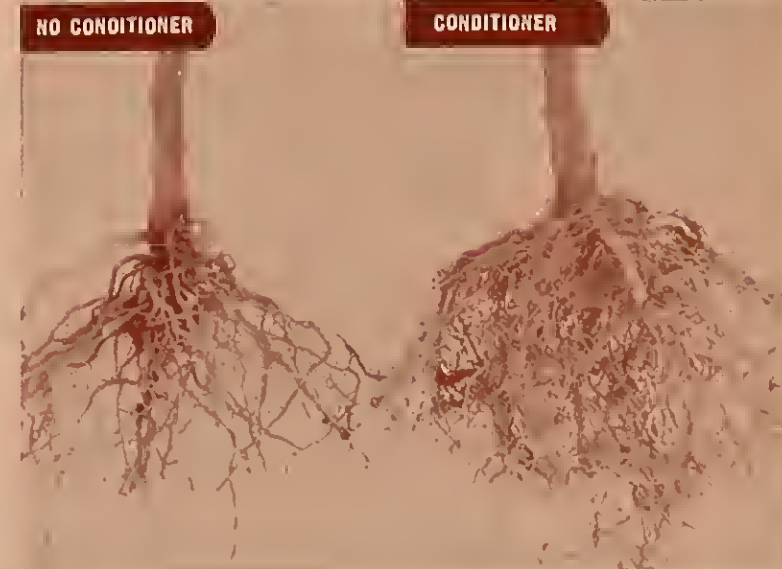
Of course, conditioners aren't magic. They don't take the place of fertilizer. They won't open up soil—that must be done by working it well at a suitable moisture level. And they must be used in proper amounts when the soil is right (faulty application or an overdose may cause gumminess), followed by thorough mixing.



TOMATO SEEDLINGS in the conditioner-treated soil outgrew plants in untreated soil. Note how this problem soil ran together and packed down (left). With conditioner, the soil stayed porous.



EARLY GROWTH AND YIELD of tomatoes on treated soil jumped as much as 2½ times, and total yield ran 20 percent higher. Plot was worked with rotary tiller. Then conditioner was mixed 6 inches deep. One part per 1,000 parts of soil was applied (this is equal to 1 per acre of soil actually treated, or ½ ton per acre).

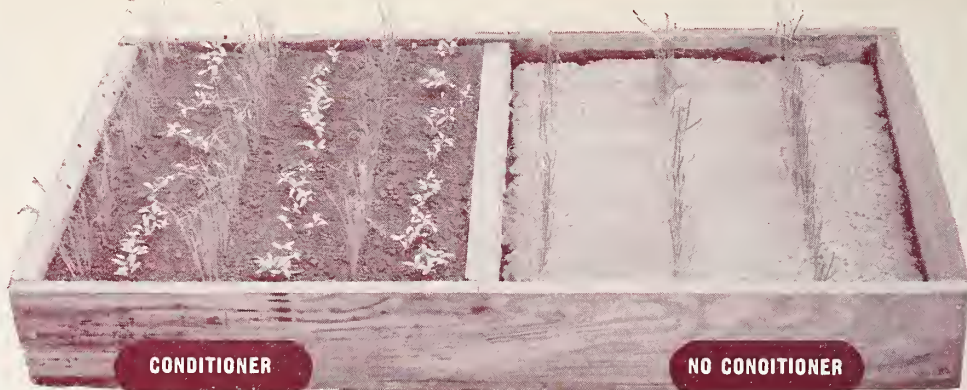


VEGETABLE ROOTS, such as these from tomatoes, develop better when the soil is in good physical condition. Root system from treated plot was able to grow more numerous feeding roots to get water and plant food. These nutrients were turned into heavier roots, a larger plant, more fruit. Scientists got similar results with other vegetables when problem soil was treated with conditioners.

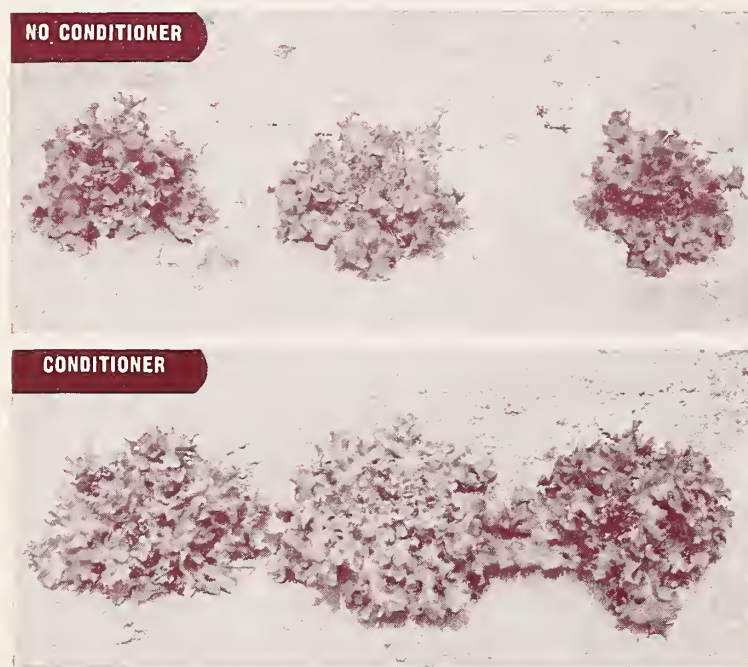
# Conditioners

(Continued)

**CRUSTING** is a difficulty with problem soils. Onions managed to pierce surface of untreated flat, but parsley didn't get through at all. Notice how soil has settled and shrunk away from box. Yet, bulk and structure of treated soil are much as at time of planting.



**LIMA BEANS** got off to a better start in conditioned soil. Yields were significantly higher than on untreated soil, which was tight and caked. (Treating the surface half-inch to prevent erosion and crusting may prove practical for extensive use on farms.) Broccoli, head lettuce, cabbage responded to conditioner by maturing much earlier; the plants on untreated soil caught up later in season.



**SALAD-BOWL LETTUCE** in treated soil was more vigorous from beginning and held this advantage through the season. VAMA, at 500 pound per acre, doubled the size of the plants. They grew nearly three times as large when the rate was increased to 2,000 pounds per acre. HPAN gave similar results at the 500-pound rate but produced no extra yield at 2,000 pounds per acre.



**CARROT** roots grew larger and better shaped in soil kept loose by an application of synthetic conditioner.



## TEMPERATURE AND TOBACCO

Farmers the country over know how flowering and fruiting depend in some cases on night length and temperature. Winter wheat, for example, won't make a crop without a long cold period, followed by ever-shorter spring nights. (See AGR. RES., May-June 1953.)

With tobacco raisers, however, neither night length nor temperature has caused much concern. The daily dark period doesn't control blossoming in most commercial varieties. Mammoth tobacco varieties—giant sports of ordinary varieties—were all believed to require long nights, but no mammoth has been widely grown. As for low temperature causing the tropical tobacco plant to bloom, this far-fetched possibility was probably never given a thought.

That's why scientists—including ARS researcher R. A. Steinberg—were surprised when he accidentally found just such a response. Already, this basic discovery has helped establish temperature as one of the factors in premature blossoming, which plagues tobacco growers everywhere.

Steinberg and his colleagues had worked for years with a nicotine-rich

native tobacco called *Nicotiana rustica*. Breeders crossed this small-leaved rustica with a mammoth variety of *Nicotiana tabacum*, hoping to develop a large plant with lots of leaves and a high nicotine content.

Repeated back-crossing to rustica, coupled with selection for mammoth growth, produced such a plant. But it practically refused to flower. Unlike true mammoths, rustica-mammoth put out only a rare bloom—even in the greenhouse during the winter when nights are longest.

The scientists tried to coax flowers by clone selection, darkness, daylight, drought, defoliation, root exposure, limiting soil, and chemicals.

It finally took a winter coal shortage to reveal what's behind the sterility of rustica-mammoth. Lack of fuel caused night temperatures to drop as low at 45° in a greenhouse normally held at 75°. Not long afterward, several plants began to bloom.

Further research confirmed that low temperature turns the flowering switch for these plants, just as suitable night length does for others.

Scientists had considered the long-night blooming character to be linked

with the character of mammoth size in tobacco. It now appears, however, that there are two types of mammoth: one, such as Maryland Mammoth, carries the familiar extra property of a long-night flowering response; but another, such as the mammoth crossed with rustica, carries a low-temperature flowering response.

Steinberg has found evidence of a similar response in commercial tobacco varieties. Growers generally try to get seed-beds planted as early in the spring as possible. But Steinberg's experiments show that the older seedlings are at transplanting time, and the lower temperatures have been during the seed-bed stage, the sooner plants burst into bloom once they're set in the field. Blossoming prevents further growth of the valuable leaves, and pinching off flower-buds is a costly job.

This indicates that some farmers might do well to wait till later in the spring to sow tobacco seed-beds.

Of course, temperature and seedling age may not be the only factors in premature blossoming. So Steinberg is continuing his study of other conditions that may play a part.

## Drought-defying Beef Maker

Air travelers over the South in the searing summer of 1952 may have noticed cattle grazing on a few patches of green pasture among countless acres of brown grassland and crops.

Those green patches were Coastal Bermuda grass. Farmers fortunate enough to have this grass on their farms say it provided feed long after other pastures had burned out.

So Coastal Bermuda—a hybrid between an outstanding domestic Bermuda grass and one from South Africa—passed its first tough test.

Farmers' experiences were much like those of the Georgia Coastal Plain Experiment Station at Tifton, where Coastal Bermuda was developed in cooperation with the USDA. Rainfall at the station was only 57 percent

of normal in June and July of 1952. But beef production dropped just 5 percent, and the hay yield was comparable to that of previous years.

Although that summer proved the drought resistance of Coastal Bermuda, its ability to produce more beef per acre than other pasture grasses is the main reason for its growing popularity. Time and again it has been the

answer for the southern farmer who thinks of pasture and hay crops in pounds of gain.

Over a 5-year test at Tifton, this hybrid grass produced an average of 116 pounds more beef per acre than common Bermuda and 52 pounds more than Pensacola Bahia grass. A 6-acre test pasture of Coastal Bermuda carried 8 steers through 5 summers and produced 278 pounds of beef per acre. In a nearby pasture, cotton-patch Bermuda carried only 5 steers and produced only 162 pounds.

Nitrogen fertilizer is turned to good use by Coastal Bermuda. (Even better in this respect is the new Tifton-developed Suwanee hybrid, which does well in deep sand. See AGR. RES., Sept. 1953.) Coastal Bermuda yielded 2 pounds of beef for every pound of nitrogen up to 200 pounds per acre applied in the Georgia tests.

Grazed from early April to mid-September, Coastal Bermuda pastures that got 200 pounds of nitrogen per

acre produced 655 pounds of gain. Pastures receiving 100 pounds of nitrogen averaged 450 pounds of gain per acre, and 50 pounds of nitrogen yielded 279 pounds of gain.

Grown with crimson clover—but no nitrogen—Coastal Bermuda grass produced 365 pounds of beef per acre. In other words, a good stand of crimson clover in Coastal Bermuda sod supplied nitrogen in addition to considerable grazing. This combination produced as much beef as 75 to 80 pounds of nitrogen fertilizer. (All plots received adequate phosphorus and potassium.)

So here's a crop that can stand up under drought and make plenty of beef—but there's still more to be said for Coastal Bermuda.

It carries a great deal of the productive vigor associated with hybrid plants. A stand of this all-purpose grass is useful the year round because it grows tall enough to make hay or silage as well as pasture. It resists

attacks of the root-knot nematode, so grows well with clover and lespedeza when properly fertilized and managed. Since it tolerates somewhat more frost than other summer-growing grasses, Coastal Bermuda can be depended on to produce more feed after the first day of August.

These advantages explain why farmers in Georgia alone have planted 500,000 acres of Coastal Bermuda.

On the matter of planting, this grass is propagated vegetatively. (There's rarely any seed in the heads.) Farmers are finding that it costs less to grow their own Coastal Bermuda planting stock in established nurseries than to start other pasture grasses from seed.

Some farmers plant Coastal Bermuda sprigs with machines designed for setting out tobacco plants, trees, or other transplants. Others get successful stands by broadcasting the sprigs and disking them into the soil, where they soon take root.

## Raising southern soybean yields

Many a southern soybean raiser could profitably boost his yields by planting at the right time and using suitable fertilizer. Research indicates that we need to change our usual practices on both points.

Soybeans gained an early reputation in the South as a hay crop that farmers could grow without fertilizer. When inoculated with legume bacteria that formed nitrogen-fixing nodules on their roots, soybeans didn't seem to respond to nitrogen applications. In recent trials, however, results strongly favor the use of lime, phosphate, and potash with this crop.

These materials enabled soybeans to produce an average of 35 bushels per acre over a 3-year period in Louisiana tests, when yields were only 21 bushels without lime or fertilizer.

In North Carolina experiments, unfertilized beans yielded 22 bushels per acre. With lime, the figure was 24.8 bushels, and with 0-40-80 fertilizer, 27.2 bushels. A crop that got both lime and fertilizer made 34.4 bushels.

Potash and phosphate also raised yields on the prairie soils of Arkansas, but did not increase production in the Delta area of Mississippi.

In general, soybeans respond to fertilizer on most soils that produce more cotton with potash and phosphate.

Time of planting has considerable bearing on soybean yields, too. There's a tendency in the South to plant too early, says research agronomist E. E. Hartwig of the U. S. Regional Soybean Laboratory.

In Mississippi, plantings between May 1 and 25 have given better results

than earlier or later plantings. Top yields in Florida have come from seeding between June 1 and 15.

Southern soybean prospects look promising to Hartwig, who works in cooperation with the Mississippi Delta Branch Experiment Station and coordinates soybean research in the 12 Southeastern States.

He points out that 35 to 40 bushels per acre isn't uncommon in some big southern producing areas. Average yield climbed from barely more than 9 bushels per acre in 1943 to 15.6 bushels in 1952.

Hartwig thinks improved varieties (see AGR. RES., Aug. 1953) and better production practices eventually may push average yields of soybeans in the South up to—and maybe above—the national average.



# Artificial Breeding

## remakes our dairy herds

**A**RTIFICIAL BREEDING has put our dairy cattle years ahead, says ARS scientist J. F. Kendrick, in charge of Dairy Herd Improvement Association work in USDA since 1933. He believes half a century of natural breeding couldn't have done as much for American dairy inheritance as artificial insemination has done in only 15 years.

With this technique, we are rapidly remaking the genetic structure of our 24 million dairy cattle, says Kendrick. By 1960, the results should begin to show up in higher national production averages.

Advancing methods and expanding organizations raised the number of artificially bred cows to about 5 million in 1953. There are 570,000 herds enrolled in the 1,600 associations operating in every State and Alaska, Hawaii, and Puerto Rico. Service is as near as the telephone for most of the country's herds.

Improvement in technique can be gauged from this fact: the average number of cows bred per sire increased from 228 in 1939—when the first artificial-breeding association was organized in this country—to 1,848 in 1952. Certain outstanding sires have been used to breed 10,000 to 15,000 cows yearly. Even that is far from the limit now possible.

Spreading the influence of such outstanding sires is, of course, the main purpose of artificial insemination. And that's where it ties in with

the testing work of Dairy Herd Improvement Associations.

Cow-testing began early in the century as a means of culling low producers. By 1920, farmers here and there were using cow records to find good brood cows and good bulls. The practice of bull proving spread, and it became apparent that scattered records needed to be brought together in a uniform program. As a result, the nation-wide DHIA sire-proving plan was set up in cooperation with the States in 1935.

But improvement was slow business. After a sire was proved by the records from five daughters, he could pass on his superior inheritance to a mere 40 or 50 offspring a year.

Then, in 1938, E. J. Perry of the New Jersey State College of Agriculture brought back from Denmark the idea of artificial insemination. This was just what DHIA's needed. Use of artificial breeding by dairymen spread rapidly after the war.

The fact is that relatively few dairy bulls have the capacity to transmit to their daughters the ability to produce large amounts of milk and butterfat. Artificial breeding now makes it possible to multiply the service of such sires when they're found in DHIA herds. Of 2,600 bulls now used by artificial-breeding associations, well over a third have proved-sire records. Their daughters average more than 1,000 pounds of milk and 40 pounds of butterfat better than their dams.

These 2,600 sires are kept at 90 studs around the country. Such a battery of bulls—a hundred or more in some cases—is usually owned by a cooperative, but some studs are privately or state owned. Semen is rushed to local associations by many means, including air drops. Even State-police radio networks help in some areas by directing inseminators to farms where service is needed. In this way, the large and small dairyman alike can use a good sire for an average of \$6 or \$7.

Present studs, with modern techniques and fast transportation, have plenty of capacity to serve the whole country. A new association need only hire an inseminator and purchase semen from an established stud.

Research by State experiment stations and artificial-breeding organizations has resulted in stretching semen further, making it last longer, and getting it to distant farms in better condition. Attention is now being given to the possibility of saving all the semen that can be obtained from exceptional sires by storing it at subzero temperatures.

From 5 million artificially bred cows, we can expect 4 million calves a year. This means roughly 2 million new heifers with improved inheritance. At that rate, we'll replace many of the 10 million cows in commercial herds of 10 head or more by 1960. And 1970 should see a big improvement in our whole dairy population.



# Chickens, Eggs, and Dollars

The progress made in poultry production during the past 20 years is a major marvel of U. S. agriculture. Output of poultry and eggs has increased faster than that of any other group of livestock products. Our poultrymen today supply a market for billions more eggs and hundreds of millions more good-eating birds than they did two decades ago.

This achievement qualifies them as experts on how research-proved practices, plus hard work, can boost farm production and earnings.

Four out of 5 farmers still keep chickens. Poultry and eggs are the third ranking source of farm income, surpassed only by meat animals and dairy products. On the average, about \$1 in every \$10 earned by farmers throughout the country comes from the sale of chickens and eggs.

In some areas, poultry products account for an even larger share of total farm income—for example, 31 percent in New England, 23 percent in the Middle Atlantic States, 62 percent in Delaware. The industry is important, too, farther west and south. It provides 13 percent of all returns to farmers in Ohio and Indiana, 14 percent in Arkansas, 18 percent in Georgia and Utah.

## Birds in Abundance

Between 1934 and 1952, egg production expanded from 95 million cases (30 dozen eggs per case) to almost 170 million cases. Poultrymeat output, which totaled 2½ billion pounds in 1934, was 6 billion pounds in 1952. Production of broilers exploded from 34 million birds in 1934 (4 percent of all poultry meat) to

886 million birds in 1952, about 45 percent of that year's poultry-meat output. In the same period, value of the broiler crop to farmers shot up from \$19 millions (at 19 cents a pound) to \$800 millions (nearly 30 cents per pound).

This tremendous increase in broilers, like the rise in poultry and egg production generally, has been due largely to research that has helped put chickens on consumer tables at prices competitive with other meats. The Sunday-dinner delicacy of years ago has become acceptable, from the pocketbook's standpoint, for any day in the week. This is true despite the fact that broiler prices received by farmers have increased 58 percent during the past 20 years.

## Efficiency Means Money

Better feeds and feeding methods, faster-growing chicks, and improved disease control reduce the expense of poultry production. Breeding for increased growth rate has been particularly important. Two-thirds of the cost of raising broilers goes for feed. Chicks that can turn their feed into meat faster will obviously help to increase farm earnings.

Investigations by P. L. Hansen, ARS economist, indicate that poultrymen operating on a continuous broiler-production plan get best annual returns by raising 3.3 to 4.1 lots of broilers per year. Assuming 2 weeks between lots for cleaning and other operations, this means that broilers can be raised profitably in 13.9 to 10.7 weeks.

Continuous producers, Hansen found, get highest annual returns by

selling broilers at 3 to 3½ pounds, depending on feed efficiency. With stable prices, they can expect little or no advantage in changing to heavier (or lighter) weights.

Poultrymen who do not operate on a continuous basis, however, may profit by raising broilers to heavier weights. This depends on local market preferences and other factors. (In New England, for instance, heavier birds tend to sell higher.)

## Feed Costs Are Critical

If a hundred pounds of feed costs \$5, and broilers sell for 25 cents a pound, most producers of single lots get better returns by feeding to 3½ pounds, provided their chicks have high feed efficiency. At broiler prices of 30 cents, it may be profitable to feed fast-gaining chicks to 4 pounds or higher.

But with chicks of relatively low feed efficiency, it will hardly pay to raise them above 3 pounds when broiler prices are at 25 cents. And when prices are around 30 cents a pound, best returns from these birds can usually be made by feeding to 3¾ pounds market weight.

In general, the higher the price for broilers in relation to feed, the higher the weight to which it will pay farmers to raise their birds. However, feeding to higher weights also increases the risk of losses in case broiler prices should drop.

## More Profit in Heavy Layers

Hens with superior laying ability, also a result of experimental breeding, likewise mean extra dollars for farmers. This has been vividly illustrated

recently in reports from North Carolina State College.

The average hen in that State produces 154 eggs a year. But the hen's feed bill takes all the farmer receives for 118 of those eggs, leaving only 36 eggs as gross profit.

A better hen, capable of laying 200 eggs annually, will eat more. But even so, her feed bill can be paid with about 130 eggs, which gives the farmer a 70-egg profit from her year's production.

A superior hen, able to lay 250 eggs a year, has a still larger board bill. About 142 eggs are needed to pay it. But the farmer's return from this hen is 108 eggs. Thus, although her feed costs only a fifth more than that of an average North Carolina hen, she is capable of returning three times more to the farmer.

Getting still higher egg and meat production in poultry lines that are already good producers is one aim of research by ARS poultrymen in co-operation with 27 State experiment stations in the North-Central, Southern, and Western regions. About 100 inbred lines of chickens are under development in this national poultry-breeding project.

### Hard-to-Crack Eggs

Proper breeding can also help solve another problem of poultrymen—losses from cracked and broken eggs. ARS researchers find that loss of egg weight during incubation is a good practical gauge of egg-shell quality: the lower the weight loss, the better the egg shell. Selecting hens for breeding on this basis, the scientists developed a poor-shell line of birds and a good-shell line.

Only 4.6 percent of the 2,891 eggs laid by third-generation hens of the good-shell line were cracked in routine collecting. But among the 2,341 eggs of hens in the poor-shell line, a total of 275 eggs, or 11.7 percent, were cracked or broken.



## LIVESTOCK

# Alfalfa saponin can produce BLOAT

Scientists and the cattle industry are making an all-out attack on the old cow-killer, bloat. First success in the campaign is the finding that saponins or associated substances in alfalfa are one cause of this ancient ailment. Final victory may still be a long way off, but the research on saponins indicates that we're on the right track in the chemical approach to knocking out bloat.

Bloat has been steadily increasing in recent years—at the same time as improved legume varieties have become available. It cuts down milk production, retards growth and fattening of beef cattle, and at worst threatens farmers with loss of good dairy and breeding animals.

Indirect losses from bloat are serious, too. To treat afflicted animals, many farmers spend money on "shot-gun" remedies that usually give little or no benefit. They may hesitate to use legumes in their pastures. As a result, pasture improvement may lag—limiting gains in efficiency of beef and milk production—on a national scale.

Bloat isn't new, either to farmers or scientists. We know from a Roman author's description of the ailment, written in 60 A. D., that its symptoms have changed little through the centuries. In fact, treatments used today for bloat are similar to those prescribed by the Romans.

The USDA, in conference with several State experiment stations and industry representatives, laid plans in December 1951 for a concerted drive to find out when, how, and why bloat

occurs, and how to prevent it. Legume saponins had long been suspected, but we had no way to isolate them in identifiable form and in amounts sufficient for test feeding. Early experiments showing that animals suffered no ill effects from alfalfa saponin were widely questioned because identity of the test material had been doubtful.

Saponins are found in many plants and are used by clinical laboratories in analyzing blood. Saponin content of alfalfa depends on variety, cutting time, soil fertility, and possibly other conditions.

W. D. Maclay and co-workers at the Western Regional Research Laboratory worked out a method for recovering several pounds of saponin per ton of dry alfalfa. Their product was tested at the Beltsville Agricultural Research Center on 5 yearling ewes, 2 goats, and 1 heifer by I. L. Lindahl and associates.

The animals were pastured on alfalfa or ladino clover for several days, then drenched with juices of these legumes to establish their susceptibility to bloat. Then alfalfa saponin—15 to 75 grams in a pint to a quart of water—was administered to each animal through a stomach tube. In 8 out of 10 tests, it caused definite distention of the rumen, severe enough in the case of one sheep (given 55 grams) to require immediate treatment to prevent death. In all cases, distention appeared due to gas retention rather than froth, since a stomach tube passed into the rumen quickly relieved the bloated condition.

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# AGRISEARCH

## Notes

### Convenient house-fly control

Ordinary sugar mixed with powdered insect poisons and sprinkled dry on the floors of dairy barns and poultry houses can give excellent control of house flies resistant to DDT and other chlorinated insecticides, ARS entomologists report from Orlando, Fla.

Dry baits of this kind are inexpensive and easy to use. As little as 1 to 4 grams ( $\frac{1}{28}$  to  $\frac{1}{7}$  ounce) of actual insecticide per barn gave kills of 90 percent or better 4 hours after application.

The insecticides tested were of the phosphate type—Diazinon, malathion, and Bayer L 13/59. Although the last two are less toxic to farm animals and humans than some other phosphate insecticides, all these materials are poisonous and must be handled with care. Applied in dry baits, however, they are normally scattered so thinly that they are not hazardous to livestock.

Most of the baits were mixed using 1 part insecticide to 100 parts sugar. About  $3\frac{1}{2}$  to 14 ounces of material was distributed per treatment. A pint fruit jar with holes punched in the lid was used to sift out the mixture. As with liquid baits, frequent applications (5 to 7 a week for the first 2 weeks) were needed for good control.

These dry baits have several advantages over the liquid type. They are more convenient to handle, more effective on porous surfaces. Flies seem to prefer granulated sugar to sugar-water solutions. But if a liquid bait is needed, the dry mixture is easy to dissolve in water.

Laboratory trials of the dry baits against flies known to have high resistance were made using specially bred flies. Every generation of these insects has been sprayed heavily with DDT for the past 8 years. The adults are

practically immune to DDT and related insecticides. But when exposed to baits having one-tenth the phosphate-insecticide dosages that were effective in dairy barns, 99 percent of these test flies were killed in 16 hours.

### Moisture-saver for dry soils

Looks like the farmer's vocabulary needs to make room for still another chemical term. This time it's "surfactants," short for "surface-active agents." These are chemicals designed to increase and conserve soil moisture.

Like detergents, emulsifiers, and textile wetting agents, soil surfactants increase water's wetting ability. They help moisture move through soil pores to subsurface layers, make it more easily usable by plants.

One promising possibility, says E. R. Lemon, ARS soil scientist working with the Texas Agricultural Experiment Station, is the use of surfactants to reduce evaporation losses that can rob the soil of a high proportion of its total rainfall in subhumid or semiarid regions. Even a small reduction in evaporation could significantly increase the moisture available to crops.

A simple way to check soil evaporation has been developed by Lemon and associates to aid in determining the moisture-saving value of surfactants. Both industry and public research agencies are intensifying study of these relatively new farm chemicals.

### More trucker-customer sales

"Availability services" now help perishable farm products find wider markets in 9 States. Developed by State departments of agriculture in cooperation with USDA marketing specialists, they give truckers and other buyers timely information on where, when, and what kind of produce is available for shipment.

New trucker-customers attracted by the Illinois service boosted sales of some fruits and vegetables 12 percent in the first season. Sales to regular customers also increased. Indiana, Kentucky, Tennessee, Maryland, Virginia, South Carolina, New York, and Oklahoma maintain similar services for certain types of produce.